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HOW TO DISINFECT TOBACCO PLANT BEDS FROM ROOT-ROT FUNGUS (*Thielavia*)

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While the root-rot fungus was first examined from Clermont County plant beds in 1899, it has not often seemed a serious disease in the Miami Valley district. It was certainly serious in the plant beds during the season of 1915, also in 1918; this root-rot continuing to cause serious losses after the plants were set in the field. In certain soils of the water-holding types, like the soils of the Southwestern Test Farm, Germantown, the tobacco crop was little, if any, more than one-third the normal average. This agrees with the experience of others in wet seasons. The work heretofore done upon the disease by Gilbert,* and by others, has shown the many sided nature of the problem.

Experiments show that the root-rot fungus may be thoroughly killed out of old plant beds by either of two tried methods of disinfection applied to the soil, viz: (1) By steaming the soil, preferably by use of the inverted pan method. (2) By means of formaldehyde (or formalin) drench upon the prepared soil of the bed.

It is to be noted:

a. That no one will care to extend his losses from root-rot into another season, if avoidable.
b. That the root-rot fungus will survive in the soil, as in old plant beds, where it has prevailed. It may survive in fields as well.

Having the whole situation before us it seems wise to kill the root-rot fungus out of plant bed soil through sterilization by steam or formaldehyde. Either of these may be applied before winter begins, if that is so preferred. It is clear that healthy plants are essential to a successful tobacco crop. First attention to growing sound plants is accordingly advised.

FALL TREATMENT OF SOILS FOR PLANT BEDS PRACTICABLE

In spring the soil is liable to be full of water, and better conditions for bed spading and preparation may be found in late fall, besides avoiding the delay in seeding which is often objectionable in spring treatment. When fall treatment is practiced, it will not be necessary to respade the beds in spring

*Gilbert, W. W., Bul. Bureau of Plant Industry, U. S. Department of Agriculture 158: 1909.

preparatory to seeding; only the surface need be worked. The object of such treatment is to destroy the forms of the root-rot fungus or other species, such as bed-rot, etc., which otherwise live over in the beds where the disease has occurred. Because the *Thielavia* fungus is found upon numerous other host plants it is not clear that new bed locations will avoid the necessity for treating the soil. For the present, it is not expected to discuss and list the plants attacked; rather to prepare a method whereby healthy tobacco plants may be produced for setting in the field.

PREPARATION OF SOIL TO BE TREATED

Previous to treatment by any method, the soil should be prepared much after the manner of preparation for seed sowing. If manure is to be applied to the bed area, make such application in advance. When chemical fertilizers are to be used, their application need not be made until spring, just before sowing seed. The soil to be treated is taken in good workable condition, certainly not over-wet, spaded to the necessary depth, and thus handled in a preparatory manner. Very dry soils have not been found satisfactory. There seems to be no need to rake over the spaded soil beyond that necessary to fine it enough to facilitate penetration of the drench or steam.

STEAM STERILIZATION BY INVERTED PAN

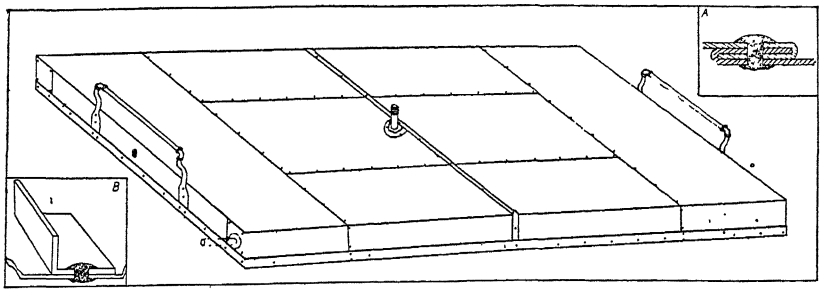
The apparatus necessary for steaming consists of an inverted pan made of galvanized iron, having nipple attached for steam hose, which is to connect the pan with a boiler of 8 to 12 H. P. capacity; the ordinary traction engine has proved serviceable in furnishing steam. A pan which will fit the usual plant bed, namely, 5 feet-6 inches by 8 feet-6 inches by 7 inches deep, is advised; this is to be made of heavy galvanized sheet iron, preferably rust proof, of 18, 20, or 22 gauge. These metal sheets, ranging in size from 2 to 3 feet wide by 8 to 10 feet long, are seamed, riveted, and braced by strap and angle iron for stiffening the pan. Four or five sheets will be necessary, as per illustration. These pans can be made by local tinner at prices ranging from $25 to $40.

After the soil is prepared, the pan is inverted over a part of the bed, with edges pressed down into the soil so as to form a steam-tight air chamber. Steam is then turned on from the generating boiler under 80 to 125 pounds boiler pressure.

The valve opening should be large enough to admit enough steam to raise temperature under pan to boiling point within 10 to 15 minutes; this will be indicated by lifting of the pan. After this is done use only enough steam to maintain the temperature as indicated by slight escape of steam about the edges of pan. From the time pan first begins to lift, 20 minutes' time is required for the steaming; this has been found as successful as a longer period. *Do not count time before boiling point is reached.**

This practice causes a rapid fall of boiler pressure up to boiling point under pan. The pressure will be regained in the 20-minute period with good firing. Smoke stack extension on boiler and location favoring good draft by wind are needed in addition to good firing to insure successful work. Good work also requires that pan be covered with rug or canvas which extends over sides of bed.

*Methods of Soil Sterilization for Plant Beds and Greenhouses. Ohio Agr. Exp Sta. Cir. 151: 1915



The above drawing illustrates an inverted pan to be 5 feet 6 inches by 8 feet 6 inches by 7 inches deep, made of 5 strips of galvanized iron with nipple for hose attachment to admit steam at top; construction lines at end indicate where steam is sometimes admitted. The inlet always to terminate in T form for dispersal of steam. The lower rim is stiffened by a continuous strap of 2 inch by 1-8 inch iron riveted to the lower edge of the pan. At ends are shown handles riveted to this stiffener and projecting above the top of the pan. Where this projection is objectionable iron pipe handles may be used with nipple base attached in the usual manner. Weight of such a pan probably less than 200 pounds.

Insert "A" shows details of folded double seam joint used in connecting the sheet iron.

Insert "B" gives details of attachment of angle iron across middle of pan; at each side this angle iron is bent over and bolted or riveted to the iron strap above described as facing the lower edge of the pan.

BED DRENCHING WITH FORMALDEHYDE

It is more convenient to drench the soil of the plant beds with a solution of formaldehyde (formalin), as only a sprinkling will be required in addition to the chemical. However, previous experience fails to show equal effectiveness in complete killing out of the plant bed fungi. The 40 percent formaldehyde may be obtained from local or wholesale druggists, and in carboys of 100 pounds may be purchased at a cost of 26 to 28 cents per pound, f. o. b., with added charge for container. In small lots the cost is much higher. Growers may profitably arrange to purchase in carboys.

The solution to be most successful probably should be stronger than that heretofore suggested, and the amount of solution applied may prove to be less with the stronger formula. The proportion of 1 gallon of formaldehyde to 50 gallons of water, and the application of one-half gallon per square foot of surface, has been suggested by Johnson* in the treatment of plant beds for a different fungus, *Pythium*. This may prove to be successful for the root-rot. For the present, a strength of 1 gallon of formaldehyde to 100 gallons of water is promising. Of this weaker solution the total application should amount to three-fourths of a gallon to 1 gallon per square foot covered. In the application, the solution should be applied as evenly as possible to avoid waste, and at two or more applications. In all cases, effectiveness is gained by covering the plant beds with canvas to prevent escape of fumes. Before applying the solution, the beds should be fairly moist and friable. If locally too dry an unevenness will show in the results of treatment. Uniform penetration of all the soil is the aim.†

*Johnson, James. The Control of Damping-Off Disease in Plant Beds. Wis. Agr. Exp. Sta. Research Bul. 31: 1914.

†Brush and log firing of beds: This is locally practiced, and is the traditional method of plant bed preparation. As a rule, the heat from this firing is not enough to kill out the root-rot fungi completely, while it does succeed in killing many weed seeds.

ADVANTAGES AND DISADVANTAGES OF STEAMING AND DRENCHING

The relative advantages of steaming compared with formalin drenching are largely in the more certain effectiveness and thoroughness of the steaming, together with the killing out of weed seeds in the plant beds, thus saving subsequent cost of weeding. Perhaps yet another advantage of the steaming is that it brings tobacco growers to realize that a real problem is to be met, not an invention of the mind, and that foresight in preparation and treatment are required. Further, it will probably be found that the heavy soils of the uplands in the Miami district will not be easily penetrated by the formalin drench. On the other hand, the gravelly soils of the valley districts will be likely to respond quite satisfactorily to the drenching method.

This circular was originally prepared to give timely advice to those expecting to grow tobacco crops in 1916. It does not cover the problems relating to the possible presence of the root-rot fungus in the soil where the crop is to be grown, but this problem may be left for the present, since it is impossible to grow a good crop without growing a healthy supply of plants. It is hoped, upon further investigation, to supply additional information regarding the root-rot problem in tobacco fields. It is urged that growers group themselves together and cooperate in the treatment work. This cooperation may apply in the combined purchase of an inverted pan for steaming the beds of a group of growers, or if the formalin drench method is used, in the purchase of formaldehyde in carboy lots.

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